White Burley Tobacco in Canada

BY

H. A. FREEMAN, M.Sc.
TOBACCO SPECIALIST

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WHITE BURLEY TOBACCO IN CANADA*

HISTORICAL

Tobacco belongs to the order of plants known as the nightshade or *solanacæ* family. The generic name is *Nicotiana*. There are more than fifty species of this genus, but the tobaccos of commercial importance on the North American continent belong to the species *Nicotiana tabacum*.

In 1866, in Brown county, Ohio, on the farm of Mr. Webb, some tobacco plants which were light-green in colour, with cream-coloured midribs and stalks, were noted in a field of what was known as red tobacco. Seed was saved from the light-coloured plants by Mr. Webb. From this beginning the new type of tobacco gained favour rapidly on account of its colour and bright, silky appearance, and its cultivation soon spread over what is known as the White Burley district of Kentucky, Ohio, Virginia, and Tennessee. From this section it is supposed to have been introduced into Canada many years ago. Only within the past few years, however, due to increases in the import duties on tobaccos, has it come to be of economic importance in this country. At present White Burley tobacco is grown only in Ontario.

This type is one of the slowest maturing tobaccos grown in Canada, consequently it is grown only where the longest season can be had. The shore districts of all counties bordering lake Erie have climates fairly well adapted to its culture. Essex and Kent counties produce the bulk of the crop, but it is being grown successfully as far northeast as Prince Edward county.

The amount of White Burley grown in Ontario has shown considerable fluctuation since 1910. In 1911 and 1913 approximately thirteen million pounds were produced. Production then decreased to three or four million pounds in 1914, 1915, and 1916. In 1919 production was again up to approximately fifteen million pounds, and in 1920 to twenty million pounds, which is the largest crop ever grown in Canada.

VARIETIES OF WHITE BURLEY GROWN IN CANADA

There are three principal varieties of White Burley grown in Canada, namely, Broadleaf White Burley, Standup White Burley and Johnson's Resistant White Burley.

Broadleaf White Burley has broad, drooping leaves of heavy body. It is a good yielder, matures later than either Standup or Resistant, and generally cures darker than the other two varieties. For this reason it is not recommended for heavy land.

Standup White Burley is characterized by a long, fairly narrow, pointed leaf which grows much more erect than the Broadlef Burley. It yields less than the Broadleaf, but if planted closely the yield will be satisfactory, and the colour bright. The Standup is especially recommended for planting on the dark, heavier soils.

Johnson's Resistant Burley.—This variety was originated by Prof. James Johnson, of Wisconsin. It is resistant to root-rot disease. In general appearance this variety seems to come between the Broadleaf and Standup Burley. The leaves are not so broad and drooping as the Broadleaf, nor quite so narrow as the Standup, which it more nearly resembles. In comparative tests on land free of root-rot disease, the Resistant variety yields less than either Broadleaf or Standup Burley per acre, but on diseased land it is practically the only variety which will make a profitable yield. For this reason it is recommended for diseased land.

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Yields.—The yield of any of these varieties depends on the soil, season, cultural methods, fertilizers and manures and varies from 800 to 2,000 pounds per acre. The average yield for the burley district is from 1,100 to 1,200 pounds per acre.

Which variety to grow.—This depends on the soil and on the market requirement for the quality produced. Broadleaf Burley for lighter sands and sandy loams, Standup for heavier sandy or gravelly loams and loams, and

Fig. 1.—An excellent plant of Stand-up White Burley tobacco.

Fig. 2.—An excellent plant of Broad Leaf White Burley tobacco.

Resistant for land diseased with root-rot is recommended as one of the general methods of improving the colour and quality of Canadian Burley tobacco, and a safe rule to follow in meeting the present market trend. The indications are that the demand for brighter leaf is increasing more rapidly than the supply in both Canada and the United States.

GROWING THE SEEDLINGS

This is a very important, as well as a tedious, part of tobacco culture, but first-class plants are necessary to first-class results. It is very important, indeed essential, to have plants sufficiently large to set in the field by May 24 to June 15.

Proper location for a seed-bed.—The best location is a well-drained spot having a southern and eastern exposure. This gives the maximum amount of sunshine and protection against the cold northerly and westerly winds. The bed should be thoroughly drained, protected from surface wash, and level. Select a warm spot on the south side of a board fence or building and run the bed lenghtwise, east and west,. or a tight board fence may be built around the plant-beds.

Soil for the seed-bed.—A good mould, fertile, well supplied with vegetable matter, and well decayed, should be obtained for growing the seedlings. Avoid a mould containing a lot of sand and poor in humus, as it packs too easily for the proper growth of the young plants, and it does not retain the sun's heat very well.

Black soil from a marshy field or from bush-land full of well-decayed vegetable matter, about two to three inches thick, should form the top of the bed in which the seed is to be sown. This makes excellent soil in which to grow seedlings as it does not pack, and absorbs and retains water and heat well. If the soil is obtained from low, water-soaked, sour marshes it should be hauled the previous spring and shovelled over or aerated a few times during the summer.

An excellent way to prepare a good seed bed soil, if black mould is not convenient, is to build a heap of grass sod and mix with manure by using a layer of each alternately, and leaving in the heap till the sod and manure have thoroughly rotted.

If the seed beds are sterilized the same soil may be used for growing seedlings for three or four seasons, at least, without changing it, but if not sterilized, new soil should be used each season to prevent diseased plants.

Types of beds.—The greenhouse bed is ideal for growing plants, although practically as good results, at much less expense, can be secured with other types of bed. The cold bed in which the soil is well worked up and covered with glass is fairly satisfactory. The same type of bed covered with cotton is too slow and is not recommended. Cotton-covered hot-beds often produce plants ready for transplanting from the 24th of May to 1st of June. Too much heat is often produced in hot-beds and the plants become spindling and yellow in colour, and a tendency to disease is frequently noted in this type of bed, however, excellent results are very often obtained.

Fig. 3.—Glass-covered houses for growing tobacco plants. (Walkerville Farms.)

The most satisfactory bed from the standpoint of earliness is the glass-covered semi-hot-bed. This is made by digging out a trench about eight inches deep and any length and width desired and filling the trench with straw, cornstalks, or tobacco stalks to a depth of six or eight inches, after which about five inches of soil is placed on the straw or stalks and the whole well packed. Then put on top of this two to four inches of mould. The bed is then ready to be sterilized.

The advantage of the semi-hot seed-bed lies in its ability to retain heat, because the layer of straw breaks the conduction of heat to the cold soil underneath, and also checks the conduction of frost from it to the seed-bed.

Sterilizing the seed-bed.—The bed should be thoroughly sterilized before seeding. Many fine seedlings are grown each year on plant-beds that are not sterilized, but also many failures are made under the same conditions. Sterilizing

the seed-bed has proven to be both practicable and profitable. The practice consists either in steaming the soil sufficiently to kill all of the weed seeds, root-rot, and damping-off organisms to a depth of three to four inches, or in treating the beds with formalin for the same purpose in part. Beds sterilized by steam will need no weeding, as only an occasional weed will appear before the seedling plants are transferred to the field. This saving of labour alone will pay the cost of sterilizing, once the equipment has been provided. Plants grown in sterilized beds are not only free from disease, but start quicker, and grow faster than those grown on unsterilized soil.

A six or eight horse-power steam-boiler maintaining a pressure of 75 to 100 pounds, and a steam-hose with connections which will stand that much pressure are needed. The sterilizing pan may be made of 18-gauge galvanized iron, and should be 6 feet wide by 12 feet long, and 6 or 8 inches deep. A tight wooden box of the same dimensions is equally as effective, but heavier to handle.

Formalin is very effective for sterilization, though steam is more convenient when a boiler is available. For small beds, and in the absence of equipment for steaming the formalin treatment may be substituted.

Fig. 4.—Glass-sash-covered seed-beds. A very satisfactory way of securing plenty of early tobacco plants.

Sterilizing with formalin or formaldehyde.—Sterilizing the beds with 40 per cent formalin or formaldehyde is very effective in preventing diseases. This treatment can be given in the fall or spring. To sterilize the seed-bed add one quart of 40 per cent formalin to 25 gallons of water and sprinkle one-half gallon of this solution to the square foot of bed. It is preferable to sprinkle the solution on the bed with watering cans, giving two applications of one quart each, in order to avoid an excess of water. After sprinkling, the bed should be covered with canvas, burlap, or sash, in order to hold the fumes in the soil for a few hours. If the beds are treated with formalin in the spring, seeding should be delayed at least six days in order to prevent any remaining formalin from

killing the tobacco seed. The frames should be placed around the seed-bed immediately after sterilizing with steam, or immediately before sterilizing with formalin. The frames are made 18 inches wide at the back and 12 inches wide in front, and are so placed that the lower side faces southward. The frames should be strong and well put together, in order to prevent the access of cold air, and to hold the heat in the bed.

When and how to sow the seed-bed.—Throughout the White Burley districts of Canada, the beds should be sown from the 10th to 15th of April with well-cleaned, Canadian-grown seed of high germinative power.

Fig 5.—Steaming tobacco seed-beds to prevent weeds and disease. All apparatus required for this work is shown: boiler, hose, and pan.

Sowing the seed is an operation in which skill and experience count for much in securing an even stand and strong plants. Assuming a well-prepared plant-bed and good seed, most growers seed their beds too heavily instead of too lightly. It is in the heavily seeded beds that spindling plants, damping off fungus, and plant-diseases in general are most prevalent. One-seventh to one-eighth of an ounce of good seed (one slightly heaping teaspoonful) to 100 square feet of plant bed is an ample quantity of seed to sow. If only two seeds out of every three grow this rate of seeding will give two plants to the square inch, and for best results the plants certainly should be no thicker.

On account of the very small size of the tobacco seed it is always necessary to mix it with some other material in order to sow uniformly. Uniform stands cannot be secured unless the seed is evenly sown in the bed. The material used for mixing with the seed should be very fine and contrast strongly with the colour of the seed-bed so that the sower may be guided in making an even sowing.

When the bed is ready for sowing, determine the amount of seed required (one-seventh to one-eighth of an ounce of seed to each 100 square feet to sow the area. Mix the seed very thoroughly with sifted wood-ashes or cornmeal at the rate of one ounce of seed to two gallons of ashes or meal. When well mixed, divide the mixture into two equal parts and sow each part as uniformly as possible over the entire bed. Dividing the seed thus will aid very much in securing an even distribution of seed, and consequently an evenly distributed stand of plants.

The tobacco seed should not be covered, but should be pressed down evenly into the surface with a board, plank or spade. A very convenient way is to have a board 10 or 12 inches wide, and 18 inches to 2 feet long with a handle on the back. This can be used to press the seed into the soil. After this is done the surface of the bed is well moistened. The water should be put on with a fine-spray nozzle; never put on enough to allow the water to stand on the surface or to run. This sprinkling insures quick and uniform germination by bringing the seed into close contact with the moist earth. *The surface of the bed should never be allowed to become dry after the seed is sown, nor should it be made too wet.* If too much water is used, the seed will be floated into masses here and there, and when the plants grow they will be too crowded in places and too thin in other places.

Seed-bed areas required.—Some definite relation between seed-bed areas and the acreage to be set to tobacco is essential. It requires from five thousand to fifty-five hundred plants to set one acre to White Burley tobacco. Fifty square feet of bed space with one plant to the square inch would produce sufficient plants for one acre. But, due to many unfavourable circumstances which often arise, it is well to have 100 square feet of bed for each acre to be planted to tobacco. There is always a demand for strong early plants.

Sprouting the seed.—Some time may often be gained by sprouting the seed, but it is often overdone. The seed should be soaked in water for two days, but no longer. Place it in a small glass and add only enough water to float a few of the seed. After soaking for two days, or thirty-five to forty-eight hours, remove the seed from the glass, spread out and allow the surface of the seed to become dry for about one-half hour. Then mix with sifted wood-ashes or cornmeal in the proportion already recommended and sow immediately. Soaking the seed till the sprouts appear is very objectionable as more is lost than gained when the seed is soaked so long.

Care of the seedlings.—If a good crop of seedlings is to be secured for early transplanting, constant attention must be given. Success or failure in growing seedlings depends on this alone, after the bed is properly prepared and sown.

Watering.—After being seeded, the beds should never be allowed to become dry unless damping-off fungus gets started in the bed, and this disease very rarely occurs before the plants have attained sufficient size to allow the bed to dry somewhat without damage. It may be necessary to water as many as three times in a day when the plants are very small and the day quite warm. The beds should never be flooded but should be well watered with a fine-spray nozzle. Early in the spring it is very beneficial to have the water slightly warm for watering the seed-bed. Watering should not be done at night or late in the afternoon if the weather is cool as it leaves the bed cold during the night and will check the growth of the tender seedlings.

Ventilation.—It is very important to ventilate glass-covered beds on every bright sunny day, and on cloudy days as well, but less frequently. Cotton-covered beds receive sufficient ventilation through the cotton. Ventilation gives fresh air and holds diseases in check. The amount of ventilation is increased as the weather becomes warmer and the plants increase in size. The ventilation should be so regulated as to avoid lowering the temperature of the bed too much. The best temperature for the germination of the seed is about 80° Fahrenheit, and the best temperature for the growth of the seedlings is 80° to 90° Fahrenheit. Therefore this temperature should be maintained if at all possible. On very close, hot days, lack of ventilation under glass might result in the plants being killed in a short time by scalding.

Hastening the growth of, or forcing, plants.—If the young plants are pale or unthrifty in appearance, or if it is desired to hasten their growth, they may be sprinkled with a solution of nitrate of soda or sulphate of ammonia in the proportion of two to three pounds to fifty gallons of water, and applied at the rate of one gallon to twenty square feet of bed. Care must be taken to sprinkle the bed with pure water immediately after applying the soda or ammonia solution, otherwise the solution will dry on the leaves and cause serious burning of the plants.

It is not well to use these fertilizing materials too freely, or growth will be forced too rapidly, resulting in weak, spindling, tender plants which will not stand transplanting very well.

Fertile plant-bed soils containing an abundance of humus do not respond to other fertilizer than nitrate of soda or sulphate of ammonia as a rule, and only require this treatment when growth is backward.

Hardening.—About eight to ten days before transplanting to the field is to begin, the canvas or glass is removed during the day, and left off during the night if there is no danger of frost, in order to harden the plants for transplanting. The watering may be diminished and the bed allowed to dry somewhat, care being taken not to harden the plants too much, or to the extent of making them woody. If the plants threaten to become too large before they are transplanted, their growth may be checked by removing the canvas or glass earlier.

The bed should be well watered before and after drawing plants for transplanting.

TRANSPLANTING

As soon as danger of frost is past, from the 24th of May to the 20th of June, all transplanting of White Burley should be done. The earlier the transplanting is done the earlier the crop will ripen. This is very advantageous in that the crop can be removed from the field before there is any danger of early fall frosts, and a longer period of good weather for curing the crop is thus had.

Selecting the plants.—When drawing plants from the bed for the field, select good, healthy, well-developed plants, as uniform in size as possible. Discard all spindling or diseased plants. This counts for much in securing uniform growth and maturity in the fall.

Drawing the plants.—Water the plant-beds well before commencing to draw plants for setting in the field. Draw the plants one at a time by taking hold of the two larger leaves. Never draw the plant by the stem or bud.

Planting in the field.—Planting is either done by hand or by a machine. A small acreage can be planted by hand, but for large acreages the machine is recommended.

The Bemis transplanter, manufactured by Fuller & Johnson, Madison, Wisconsin, is regarded as being a standard. There are also other transplanters which give satisfaction.

For hand planting, it is best to plant after showers or rains, but with the machine, planting may be done at any time.

The plant should be well placed in the ground, leaving the heart scarcely above the surface. The soil should be pressed compactly about the roots of the plant.

The best distance for planting.—This depends somewhat on the soil. Very fertile, well-manured soils should be more closely planted than soils less fertile. As a result of a three-year experiment conducted on the Experimental Station at Harrow, Ont., the following distances have been recommended for transplanting the different varieties of White Burley:—

Fig. 6.—The tobacco-transplanting machine at work.

Broadleaf White Burley—44 inches by 28 inches
Standup White Burley—42 " " 26 "
Resistant White Burley—42 " " 26 "

No doubt further study is needed along this line in Canada, because it is known that the distance between plants in the row, and the distance between the rows has a marked effect on the tobacco leaf, but the best distance for each section and soil type must be determined by the grower through his own experience and the experience of others under like environment. The size of the leaf, its thickness, its elasticity, size of veins, quality and curing are all more or less modified by too little or too great distance between rows or between plants in the row. In Kentucky, where the White Burley has been grown extensively since 1866, it is planted in rows 3½ to 4 feet apart, and from 18 to 24 inches in the row, with a resultant quality and colour superior to that from plants set further apart.

THE PROPER SOIL FOR WHITE BURLEY TOBACCO

The best White Burley soils are the sands, sandy loams, and gravelly loams, preferably of limestone origin. Fairly good results have been noted on light clay loams in normal seasons. However, under our climatic and seasonal conditions, the sandy and gravelly loams, containing good quantities of humus, and liberally manured, are the most dependable soils for the production of quality and quantity of tobacco of the White Burley type in this country. Heavy clay, or heavy clay loam land, is not recommended for tobacco. During wet seasons or heavy rains the water stands too long on heavy soils and the tobacco is drowned out. On such lands the crop matures later, is coarser, dark-coloured and generally lacking in quality.

Tobacco lands should be well drained. Any land of a cold, wet nature should never be set to tobacco.

Land having a southern or southeastern exposure is preferable for tobacco-growing, although an eastern or western exposure may give good results. A northern exposure is the least desirable location for a tobacco-field.

A tobacco-soil should be fertile, friable, and have a large store of organic matter to produce the best results with White Burley.

Muck soils which have been under observation have not produced a good quality of White Burley.

White oak, beech, walnut, maple and hickory clearings are famous for the production of fine quality White Burley in Kentucky, U.S.A.

The following table gives the mechanical analyses of a few of the typical White Burley soils:—

MECHANICAL ANALYSES OF SOILS NOW PRODUCING WHITE BURLEY TOBACCO IN CANADA, AND SOIL CLASSIFICATION.

No.	Depth	Locality	Loss on Ignition	Gravel 2-1 mm	Coarse Sand 1-.5 mm	Medium Sand .5-.25 mm	Fine sand .25-.1 mm	Very fine sand .1-.05 mm	Silt .05-.005 mm	Clay .005-00	Classification
547	0″–30″	Kentville Tobacco Station..	5·09	12·23	16·92	27·95	12·07	11·31	12·37	19·31	Gravel loam
556	0″– 8″	Peter McPherson, Blenheim	7·14	12·70	10·88	25·34	5·63	10·07	32·22	3·17	" "
557	8″–36″	Subsoil to 556.....	4·92	17·86	16·18	38·58	3·73	4·42	15·24	4·00	" "
560	0″–10″	Davidson & Wellington, Fonthill.....	2·25	·46	2·95	56·02	11·09	9·94	14·85	4·69	Sandy loam
561	10″–36″	Subsoil to 560.....	3·70	·88	2·93	47·17	15·06	14·02	17·89	2·06	" "
568	0″– 7″	Sam Buchanan, Rondeau...	5·41	·39	·63	1·61	18·31	34·65	30·53	13·89	Fine sandy loam
569	7″–30″	Subsoil to 568.....	5·05	·34	1·08	1·53	18·72	33·93	30·04	14·47	" " "
570	0″– 7″	Tom Driver, Palmyra.....	9·00	5·64	8·98	22·29	8·90	12·82	29·89	11·49	Coarse " "
571	7″–30″	Subsoil to 570.....	4·24	11·21	14·35	25·94	7·10	10·76	20·74	9·92	Gravel loam
574	0″– 7″	J. C. McGuigon, Cedar Springs.....	6·26	2·89	7·40	34·63	19·55	4·64	27·28	8·25	Sandy loam
575	7″–36″	Subsoil to 574.....	2·57	2·18	7·15	41·01	23·08	4·03	15·07	7·49	" "
582	0″–10″	J. H. Willson, Ridgetown...	4·35	15·13	15·56	21·30	13·45	5·26	15·48	13·83	Gravel loam
583	10″–36″	Subsoil to 582.....	4·80	3·32	5·06	16·84	29·68	17·29	14·13	13·67	" "
584	0″–12″	D. E. Desmond, Morpeth...	4·35	12·16	15·11	20·67	7·40	6·37	27·19	11·11	" "
585	12″–36″	Subsoil to 584.....	3·72	18·22	18·21	20·98	5·71	4·70	19·87	12·31	" "
586	0″–30″	G. M. Eastlake, Highgate..	4·77	10·12	12·69	25·94	4·57	11·13	23·63	11·93	" "
588	0″–24″	Harrow Tobacco Station, Harrow.....	1·87	·29	·66	40·75	35·49	6·96	11·04	4·82	Sand soil
631	0″–10″	R. L. Wilby, Locust Hill...	6·88	1·39	2·64	17·20	14·90	17·94	34·12	11·82	Fine sandy loam
632	10″–36″	Subsoil to 631.....	8·74	2·25	3·30	17·96	16·90	14·14	29·16	16·29	" " "
633	0″– 6″	Walkerville Tobacco Farm, Walkerville.....	6·28	9·65	10·92	34·02	5·86	5·41	20·13	14·01	Sandy loam
634	6″–36″	Subsoil to 633.....	1·70	4·09	11·57	58·78	4·45	3·86	9·16	8·09	Sand soil
635	0″–14″	A. J. Lake, Picton.....	2·13	·38	·89	39·58	31·66	13·33	10·46	3·71	" "
636	14″–36″	Subsoil to 635.....	1·47	·93	2·11	40·63	27·94	13·12	8·70	6·58	" "
637	0″–10″	S. C. Peck, Rednersville....	3·00	·29	·71	27·74	47·50	11·35	7·91	4·50	Sandy loam
638	10″–36″	Subsoil to 637.....	1·28	·15	·51	33·25	46·49	8·43	4·40	6·76	" "
639	0″–10″	W. P. Peck, Carrying Place	4·08	·29	·15	·42	43·17	30·25	17·46	8·23	Fine sandy loam
640	10″–36″	Subsoil to 639.....	1·38	·10	·24	8·63	42·19	28·56	17·07	3·21	" " "
641	0″–10″	Wm. McCartney, Picton....	4·49	·72	2·86	38·39	9·98	10·62	27·44	9·99	Sandy loam
642	10″–36″	Subsoil to 461.....	4·09	·92	2·17	26·12	21·31	10·95	24·51	14·02	" "
649	0″–40″	Dr. Burt, Simcoe.....	1·52	·33	·34	15·10	45·70	26·95	8·15	3·74	Fine sand
671	0″–40″	T. E. Chalk, Calton, Elgin County.....	1·26	....	·27	19·71	42·79	24·49	8·87	3·86	" "
643	0″–40″	Charlotteville Tsp., Conc. 12, Lot 5, Norfolk Co.....	2·70	1·50	6·49	75·62	4·93	4·28	5·09	3·59	Sand
644	0″–40″	Ditto Conc. 11, Lot 7.....	2·93	....	·19	21·66	40·30	27·48	7·82	2·55	Fine sand
654	0″–40″	Ditto Conc. 12, Lot 4.....	2·41	1·00	1·80	76·48	9·28	3·63	5·35	3·46	Sand
677	0″–10″	Wm. A. Curry, Ridgetown..	7·67	·30	·30	7·55	47·24	22·01	13·28	8·62	Fine sandy loam

This table shows the amount of sand, silt and clay in our White Burley soils, and on this basis gives the soil classification.

Experiments and observations extending over the past five years throughout the White Burley tobacco area of Ontario lead to the conclusion that the best soils for the production of this type of tobacco are the gravel and sand loams containing fifty to seventy per cent of sand, ten to twenty per cent of silt, and eight to twenty per cent of clay.

Heavier soils than this have not been satisfactory.

PREPARATION OF THE LAND

The proper preparation of the land for the tobacco crop is frequently given too little attention. It is in reality the most important cultivation that the crop ever gets. A good crop of tobacco is very rarely harvested from poorly prepared land.

Judging from the results of careful tests made during the last few years in the tobacco-growing districts of Ontario, the tobacco land should be manured and well ploughed in the fall. The breaking of the land should be thorough and and at least eight inches deep.

The fibrous-rooted tobacco plant seeks its food near the surface, but the subsoil should not be neglected because of this fact, for on the condition of the subsoil depends largely the moisture content of the surface soil.

Fall ploughing allows a better distribution of labour, is one of the most effective means of combating insect pests, especially the cutworm, and conserves sufficient moisture to take the crop through severe drought without checking the growth to anything like the extent that growth is checked on spring-ploughed land during dry seasons. In carefully conducted plot experiments land fall-ploughed has given better yields of tobacco than spring-ploughed land of the same type.

If the land is spring-ploughed it should be done as early as possible, and thoroughly worked up with the disk and harrows. The soil must be in a condition to admit air to the rootlets, and also to the beneficial nitrifying bacteria in the soil, and at the same time it must have the ability to hold sufficient moisture for the needs of the crop. This condition can be reached only by a thorough preparation of the soil before planting time.

The land should be harrowed after each rain until the tobacco is transplanted, in order to keep the soil in good tilth, keep weeds in check, and prevent excessive loss of moisture by evaporation. When the land has been worked up to good tilth, and immediately before transplanting is to begin, it should be smoothed with either a spring tooth harrow or a plank drag, but it should never be smoothed with a land roller as this leaves the land packed and in poor condition for the seedlings.

ROTATIONS

The best conditions for growth in the soil as well as keeping up the fertility are greatly dependent on a good system of crop-rotation in the production of tobacco or any other field-crop. Good practice and experimentation have always shown that it pays to rotate from the standpoint of soil-fertility, disease and insect-pest control, and total profit to the grower over any period of time. The humus supply, a very important consideration in White Burley production, can hardly be maintained in any other way than by a rotation in which grass and green cover-crops are included.

Where both corn and tobacco are grown, a suitable rotation would be: 1, Tobacco; 2, Wheat; 3, Grass and clover; 4, Corn. In this rotation tobacco follows corn. For corn, any manure available is used on the clover sod, and

commercial fertilizers may be used for the tobacco. The corn with its long growing season, and the great foraging power of its roots, will make the best use of the slowly decaying organic matter. For this reason the bulk of the manure may be applied to the corn. Tobacco with its less extensive root-system and short growing season may derive as much benefit from these materials the second year when they are turned up as it would the first year. This rotation puts the soil in excellent shape for both corn and wheat and is very favourable to the growth of tobacco and grass or clover.

While two crops of White Burley tobacco are sometimes grown on the same land with fair success, and sometimes a third crop may be successful, it seems far better to rotate each year.

A good three-year rotation would be: 1. Tobacco; 2. Grain; 3. Clover.

In view of the fact that a very fine quality of White Burley tobacco is produced in Kentucky, U.S.A., and in view of the fact that practically the world's supply comes from that state, it might be well to mention the system of rotation followed there.

On old land the tobacco crop is usually followed by wheat sown in the fall with timothy and clover. The land is allowed to remain in clover and timothy for several years. In about two years the clover disappears, and in about four years the timothy disappears and is superseded by bluegrass. When the bluegrass has become well sodded, the soil is again prepared for tobacco.

On new lands two crops of tobacco are grown in succession. After the first crop is taken off, the land is sown to rye and the rye is turned under in the spring for the second crop of tobacco. After the second crop is harvested timothy is sown in the fall, and clover sown in the spring. After three years in timothy and clover another crop of tobacco is grown. After the land has produced a third crop of tobacco the rotation is the same as for old land.

Another rotation also carried out on new land is as follows: 1, Tobacco; 2, Tobacco; 3, Wheat; 4, Clover, timothy, bluegrass; 5, Clover, timothy, bluegrass; 6, Timothy, bluegrass; 7, Bluegrass.

Since bluegrass is slow in forming a heavy sod, advantage is taken of this to secure two crops of clover and timothy.

In Kentucky, where the farms are large, and the tobacco acreage per farm comparatively small, and where live stock raising and dairying are extensively carried on, there is a demand for considerable hay and pasture on the farm. Clover and timothy, both of which grow well throughout the tobacco-producing area, furnish the hay, and the pasturage is furnished by bluegrass for which central Kentucky is noted. Humus, which is very essential for the tobacco, is added to the soil by the hay and bluegrass sod, instead of by the use of manure. It is believed in Kentucky that this method of managing the rotation and maintaining the humus supply of the soil enables the grower to produce good yields and an excellent colour and quality of Burley tobacco.

The above facts may be responsible for the difference in the rotations followed in Kentucky and Canada.

Soils that are diseased with root-rot should not have clover and other legumes grown on them in the rotation, as the disease lives on the clover roots as easily as on tobacco roots, but it is not able to live on the roots of grasses and grains. Therefore it would seem that, on diseased land, timothy, orchard grass or red top should be grown without clovers and other legumes.

MANURING AND FERTILIZING THE CROP

It is believed that by heavy manuring and fertilizing and closer planting, a great deal could be done towards improving the quality, colour, size and yield of Canadian White Burley tobacco. It is also believed that the percentage of low-grade leaf in White Burley could be very materially decreased in this way.

Ten to twelve tons of barnyard manure per acre applied in the fall and ploughed under is the practice generally followed. In the spring any fertilizers may be applied in the row, one to two weeks before transplanting, or broadcast and lightly worked into the soil with drag-harrows. Light applications of fertilizers might preferably be applied in the row, but with applications of 700 to 1,200 pounds per acre it is believed that little difference will be noted between broadcasting and drilling. Differences noted are apparently due more to the season and soil than to the method of applying the fertilizer.

Where tobacco follows corn in the rotation, it is believed to be better to apply the manure to the corn, unless there is sufficient for both crops, and to depend on commercial fertilizers for the tobacco crop. In the production of fine quality Burley it will no doubt always be better to apply the manure to the preceding crop.

The fertilizers may be brought and mixed at home with a very material saving in the cost of them to the tobacco-grower.

Those who desire to apply commercial fertilizer liberally need not fear that it will hurt their land, or that once used it must always be used. Used intelligently commercial fertilizer will be found quite profitable.

Effects of fertilizers and manures on quality.—As a rule, within certain limits, anything which increases the yield usually improves the quality of White Burley tobacco. Commercial fertilizers containing large quantities of readily available plant food tend to thicken the leaves, producing heavy-bodied tobacco. Manure, on the other hand, tends to produce a large, thin, flimsy leaf. The same effect is produced on new lands which have large amounts of organic matter. This tendency to become flimsy can be corrected by using high-grade commercial fertilizers in conjunction with the manure.

Special fertilizer requirements of the tobacco crop.—The amount of fertilizer or manure to use depends on the soil and on the crop. In all our experiments phosphorus in the form of acid phosphate has been shown to be needed on all tobacco-soils and, until this was supplied, an application of nitrogen or potash produced little effect. All plants use phosphorus, nitrogen, and potash in making growth, but not in the same proportions. Tobacco is a heavy feeder on potash, hence this element should be used in good quantity. The actual plant food required for producing a tobacco crop of 1,200 pounds of leaf, plus the stalks, per acre is as follows:—

Nitrogen—55.5 pound, equals 277 pound sulphate ammonia.
Potash—42.2 pound, equals 85 pound sulphate potash.
Phosphoric acid—8.0 pound, equals 50 pound acid phosphate.

It has been found by experiment on the Dominion Experimental Station, Harrow, Ont., that in a regular four-year rotation of corn, tobacco, grain and grass, a very profitable amount of fertilizer to use is as follows:—

Sulphate of ammonia—350 to 400 pound per acre.
Acid phosphate—400 to 500 pound per acre.
Sulphate of potash—150 to 200 pound per acre.

This equals a ready-mixed fertilizer having the formula 4-4-5 in the order given above, and used at the rate of 2,000 pounds per acre.

It is recommended, where ten to twelve tons per acre of barnyard manure is used, to decrease the sulphate of ammonia to 150 to 200 pounds per acre.

Co-operative fertilizer experiments were conducted with growers in the White Burley district on sandy loam soils, which were quite representative of the area, and on which a regular four-year rotation, including clover for hay, was followed. The clover sod was manured heavily, fall-ploughed, and tobacco set the following spring. The following conclusions were drawn from these experiments:—

1. Acid phosphate and sulphate of potash can be very profitably used along with the barnyard manure in growing White Burley tobacco, the quality of the leaf being thereby improved and the yield per acre increased.

2. On land in good tilth, heavily manured, and where clover is grown in the rotation, additions of ammonia or nitrogen in fertilizers may not be profitable.

3. On land well manured, and where clover is grown in the rotation, a very profitable and economical rate of fertilizing for White Burley seems to be 500 pounds of 16 per cent acid phosphate and 100 to 150 pounds of sulphate of potash per acre.

4. On light sandy loams, and sands not so heavily manured, applications of 150 to 200 pounds of sulphate of ammonia, 500 to 600 pounds of acid phosphate, and 100 to 150 pounds of sulphate of potash mixed and applied at this rate per acre is recommended.

Profit from the use of fertilizer.—The amount of fertilizer that may be used with the greatest profit depends upon the natural condition of the soil, the season, and the value of the tobacco per pound. During the past four years, in co-operative experiments and on the Experimental Station, Harrow, the quantities of fertilizers recommended in the preceding paragraph have returned a profit of from $2 to $3 for each dollar spent for fertilizer above the cost of the fertilizer. During these years the price paid for tobacco has been profitable, but the price paid for fertilizers has been very high compared to former years.

CULTIVATION

The cultivation of tobacco should begin soon after the plants are set, or in six to eight days. If set by hand and after a rain, the tramping will not leave the surface of the soil in a desirable condition and it should be pulverized as soon as possible.

Fig. 7.—Field of White Burley tobacco in Norfolk County. Set three weeks.

While the plants are very small it will do no harm to cultivate deeply, and will be advantageous where the soil is hard or has a tendency to become compact. The depth of cultivation will vary with the conditions of the soil and season. In general, however, it should be shallow, and the ground should be kept level. Many growers in Essex and Kent counties undoubtedly decrease their yields

of tobacco by too deep cultivation, especially during the middle and latter part of the cultivating season.

The essential thing in cultivation is to conserve moisture by keeping a mulch on the surface of the soil, and to keep weeds in check. Cultivation is profitable even when rains are lacking, and should be done at regular intervals. As soon as the soil is dry enough after each rain cultivation should be given. If the cultivation is frequent enough and thorough enough, practically all weed growth can be controlled.

Just what kind of cultivation should be given and the implement that should be used will depend on the season and the amount of the weed growth. Weeds crowd the tobacco plants and consume fertilizer intended for the latter's use.

The hand hoeing of tobacco is quite expensive, and should be materially reduced by the timely and thorough use of the cultivator. However, hand hoeing is used to good advantage when there are any weeds or grass in the tobacco row which would not be reached by the cultivators.

Fig. 8.—Tobacco-cultivator at work.

The two-horse cultivator, sometimes called the "tobacco-hoeing machine," carrying a seat for the driver and provided with fenders, is generally used throughout Ontario for the cultivation of tobacco. The Fuller and Johnson cultivator is regarded as standard. The tobacco and corn-cultivators are very similar except that certain types of tobacco-cultivators require an additional man to operate the hoes when the tobacco becames larger.

Care should be taken to avoid injury to the plants when cultivating, as any bruising or tearing of the leaves during this operation will injure both the yield and the quality of the tobacco.

The period of cultivation ends when the leaves have spread so wide as to obstruct the space between the rows and prevent the passage of horse and cultivator.

TOPPING

Possibly the two most important considerations in better White Burley tobacco in Canada are early planting and proper topping.

Time and height for topping.—All tobacco should be topped four to six weeks before it is to be harvested or cut. It is also recommended to top just as soon as the young seed-head or button can be reached and pinched out. If tobacco has been planted at the proper time—May 20 to June 15 or 20—topping should be delayed till the young seed-head appears, because it will appear five or six weeks before harvesting time. Where it was impossible to plant the tobacco on time, but was necessary to grow it, topping should at least be done at the proper time regardless of the size of the tobacco. Such topping will invariably prove profitable, and is advocated on that basis. Four to six weeks is required to bring a small top leaf to the proper size and maturity for harvest.

Fig. 9.—Field of White Burley about ready to harvest. (Experimental Station, Harrow, Ontario.) This tobacco was topped four weeks before the picture was taken. Note the size and development of the top leaves; this shows the result of proper topping.

The field should be gone over several times in order to top the plants, since all seed-heads or buttons do not appear at the same time. The removal of the seed-head does away with the demand for seed-production, and the plant food intended for its development remains in the leaves to improve their quality and add to their weight.

How many leaves should be left on each plant is a question that is often asked, but that depends on so many variable factors that a definite answer cannot be given. The main factors are the condition of the weather, time of the season, and the fertility of the soil. It is as much a question of how many of the upper leaves must be removed in order that all that remain may reach full development, as it is a question of how many of the bottom leaves may be saved. The greater the number of leaves left on the plant the less chance each has for

development as a rule. The more advanced the plant is the larger the top leaf left should be, as growth is much less rapid as the plant approaches full development. In dry weather, a larger top leaf should be left than when there is abundant moisture in the soil. Care should be used in removing the seed-head not to injure the small top leaves and thereby injure the crop. It is safe to say, however, that the White Burley crop of this country is far more often injured by delaying topping than by premature topping.

It is customary to leave from twelve to sixteen leaves on White Burley tobacco, but the exact number of leaves must depend on the experience and judgment of the grower.

SUCKERING

When the seed-head or button is removed, buds in the axils of the leaves start to develop. They are called "suckers." These suckers should be removed since they consume material that is needed for the development of the leaf. The suckers are removed as soon as they are about three or four inches long. If allowed to become too large they cannot be removed without damaging the leaves. The longer they remain the more harm they do in drawing nourishment from the plant and in injuring the quality of the leaf. In warm, moist weather the suckers grow very fast, but they should be kept in check by removing them as often as necessary. It should not be a question of how many times to sucker the crop, because it will pay good returns on the cost of the labour involved to keep the suckers removed. Leaves from unsuckered tobacco are thin and papery and lacking in gum and elasticity. From this it can be seen that the real object of suckering is to produce better body and development in the leaf.

INSECT PESTS

The most common and troublesome insects which the Canadian tobacco-grower has to combat are the wireworm, cutworm, tobacco hornworm, and grasshopper.

Wireworms.—The wireworm usually attacks the plant soon after it has been transplanted. Starting near the roots, it bores its way into the plant and upward through the heart. Since the plants attacked do not die for some time, and, if the weather is cloudy and cool, do not even wilt, this insect is especially troublesome in securing a good stand of tobacco. The field may be reset several times under such conditions without detecting all the damaged plants.

The most effective means of controlling this insect consists of rotating the crops in such a manner that tobacco does not come on sod-land, but follows a hoed crop. Fall ploughing, followed by spring cultivation to keep down the grass and weeds in order to starve it out before the tobacco is transplanted, is also very effective.

Cutworms.—The cutworm is also a serious drawback in obtaining a good stand of tobacco. This insect cuts the plants off near the surface of the ground and frequently necessitates several replantings of the crop.

The cutworm may be largely controlled either by fall ploughing or by the use of poisoned baits. Fall ploughing after the 20th of September, at about which date the moth stops laying its eggs, is very effective as a control measure. The use of a mixture consisting of one pound of Paris green, fifty pounds of bran, and one gallon of molasses is also beneficial. The bran and Paris green should be mixed dry, the molasses added, and enough water to make the mixture as moist as possible, and yet have it retain a granular consistency, so that it will fall through the fingers like wetted sawdust. This should be sown over the field broadcast several days before planting, first going over the field and killing or covering up all weeds and grass. The bran mixture should be scattered on warm

evenings and not in the heat of the day or in cool weather. If this mixture is applied after transplanting it is not so effective and frequently the tobacco plants are burned by coming in contact with the Paris green. The quantity of mixture given here is sufficient for one acre. Spraying the plants drawn for transplanting, with a solution of arsenate of lead, at the rate of 1½ ounces of dry, powdered arsenate of lead per gallon of water, long enough before setting in the field to allow the plants to dry, is also beneficial.

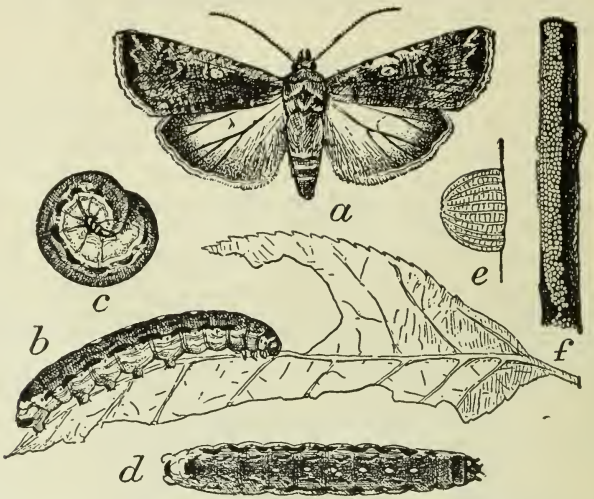

Fig. 10.—The Tobacco-cutworm (Variegated cutworm). (*a*) Adult; (*b*, *c*, *d*) Larvae; (*e*, *f*) Egg. (After Howard.)

The Hornworm.—Most growers are acquainted with it as the light-greenish, horned worm which infests the tobacco fields from July to September. It is often seen feeding on tomato vines as a large, light-green, horned worm, in many sections where tobacco has not been previously grown, but when tobacco is introduced it at once infests the tobacco fields. These worms are very heavy feeders and grow very fast. The adult is a large, grey, flying moth which appears in the tobacco fields about dusk and lays small, greenish eggs, usually on the underside of the leaf. The eggs soon hatch and the larvæ begin eating the tobacco leaves at once. When full grown they crawl into the ground three or four inches deep and go through a resting stage as pupæ. Fall ploughing will expose these pupæ to freezing and thawing, which kills large numbers of them.

Spraying the tobacco with arsenate of lead as soon as the worms appear in appreciable numbers, is about the safest and most effective method of combatting the tobacco hornworm. Paris green is also good for this purpose; however, there is more danger of burning the tobacco with the Paris green and too, if the tobacco is sprayed too frequently with the latter, there is a tendency for the leaf tissue to be killed just at the point where the leaf joins the stalk. As a result, the leaves break off much more easily at the time of harvest. The Paris green also washes off more readily, and therefore loses its effectiveness more quickly than does the arsenate of lead.

Arsenate of lead may be applied either as a dry powder or in solution. It has been found that until the tobacco is about half-grown, a solution consisting of 6 pounds of dry, powdered arsenate of lead per 100 gallons of water is most effective. The solution apparently covers the plant more completely and adheres to it longer than does the powder. After the tobacco becomes too large to get through it with a spray-cart, the dust- or powder-gun may be used. For use in

the dust-gun, the dry, powdered arsenate of lead should be mixed with equal parts of dry, sifted wood-ashes, or, if they are not obtainable, the next best carrier is dry, air-slaked lime. The powder should be applied early in the morning while the dew is on the tobacco and when there is no wind blowing. Apply at the rate of five pounds of arsenate of lead per acre on large tobacco and three and one-half pounds per acre on small tobacco.

In purchasing the arsenate of lead, the buyer should demand the form having at least 30 per cent arsenic oxide; other forms with a lower arsenic oxide content are too slow in their action to give the best results. It is also important that the powder does not have more than one per cent of the arsenic oxide in a free, or water-soluble state, as a higher percentage of water-soluble arsenic oxide may burn the tobacco.

Fig. 11.—The tobacco-worm or hornworm. (*a*) Moth; (*b*) Larva; (*c*) Pupa. (After Howard.)

If the paste form is used, the amounts previously mentioned should be doubled, as this form has only one-half the strength of the powder.

Grasshoppers.—Some years grasshoppers are a source of considerable loss to the grower. These pests fly from one plant to another, eating small holes in the leaves, and in a short while cause the whole field of tobacco to have a very ragged appearance. Scattering the poisoned bran mixture, previously mentioned for cutworms, to which the juice of six oranges or lemons has been added, around the edges of the field will be found very helpful. Spraying the first five to eight rows of tobacco with a solution of one pound of arsenate of lead to thirty gallons of water around the edges of the field would no doubt do a great deal to check the invasion of the tobacco field by the grasshoppers.

The Dominion Entomologist reports that the most economical and effective formula used so far in Canada for controlling grasshoppers is as follows: 20 pounds bran or half-and-half bran and sawdust; $\frac{1}{2}$ pound Paris green; $\frac{1}{4}$ pound

ordinary table salt. Water is added so that while the mixture will be moist it will not lose its granular consistency.

This mixture should be thinly broadcast over the field that is infested, or over stubble-fields adjoining the tobacco-field, choosing the early morning preferably for the operation.

It is also beneficial to plant several rows of corn around the tobacco-field. These pests pass the winter in old fence rows, meadow lands, and weedy fields. Fall ploughing of such lands will serve to decrease their numbers very appreciably.

DISEASES OF TOBACCO

"Tobacco root rot" (4).—The tobacco root-rot, caused by the fungus *Thielavia basicola* (B. & Br.) (Zopf.), is one of the most common diseases of tobacco in Canada. It causes the growers thousands of dollars in losses annually in decreased yields, inferior quality, and, in some cases, total failure of the crop.

Fig. 12.—A field of tobacco badly diseased with root-rot. Note the uneven size of the plants, all of which were set on the same date. The large plant with seed-head bagged shows strong resistance to the disease. Seeds from such plants as these are saved as foundation stock for selecting tobacco resistant to the disease.

This fungus attacks the entire root-system, but more especially the young fibrous roots of the plant, causing them to decay. These roots then cease to function as food carriers and, as a result, the plant is starved. The degree of starvation depends upon the extent to which the plant and field are infected, the climatic conditions prevailing at the time of transplanting, and the hardiness of the plant. Some plants may die; however, with the majority, the roots apparently function enough to keep the plant living, but not enough to enable it to make any growth. The diseased plants generally remain small until late in the season when, due to warm weather, they may begin to grow; however, such plants never attain normal size or maturity and are usually harvested green.

This disease attacks the plant in the field and in the plant-bed. In the plant-bed the plant usually has a yellow, unthrifty appearance, and its growth is comparatively slow; however, this is not always the case. Often, upon examination, plants which have a good colour and are making satisfactory growth in the bed will be found to be infected.

In the field the plants show the same unthrifty appearance and lack of growth and often the field will have a checkered appearance, there being several small plants followed by large, healthy plants. This condition may prevail throughout the field. In either case, upon carefully pulling up the plant and examining the fine roots it will be seen that they have turned black and are rotten.

After the plant has become completely infected no amount of cultivation or fertilizing appears to be of value in starting it to grow. If healthy plants are transplanted in slightly diseased fields, which have been thoroughly prepared, and climatic conditions are favourable to quick growth, the plants are apparently able to resist the disease and make a normal growth. On the other hand, a continued wet spell, or anything which tends to weaken or check the growth of the plant, apparently lessens its resistance to the disease, and the degree of infection is increased.

In preventing the disease it is necessary to produce absolutely healthy plants and transplant them to undiseased fields. The plant-beds must be thoroughly sterilized before seeding. No plants should be transplanted from a diseased bed, as they will serve to spread the disease over the entire field very quickly. If the fields become diseased, a good four or five year rotation should be practised. Since many legumes, especially red clover and alfalfa, are host-plants of the root-rot they should be left out of the rotation.

On lands which are diseased, or which are at all likely diseased, the growing of Johnson's Resistant White Burley is strongly recommended if these lands are to be devoted to tobacco production.

Bed-rot or Damping-off fungi.—The rotting or damping-off of the young seedlings in the plant-bed is caused by fungi, which spread very rapidly in circular or irregular patches in which practically all of the plants in the infected area fall or wilt down and rot. The plants attacked by this disease usually begin to rot near the surface of the ground, though the infection may spread up the stalk and even the leaves may become decayed. Infected plants generally die, though some may recover, giving evidence of the attack by a brownish, deadened area on the stalk near the root. Such plants should be discarded as they seldom prove satisfactory if transplanted. This disease is most prevalent in thickly seeded beds which are very moist and lack ventilation.

Sterilization of the seed-bed, and seeding thinly, are the most effective methods of preventing the disease. After it occurs it may be checked by throwing out the infected plants, lowering the temperature by ventilating the bed well, and allowing the bed to dry out for a while. In warm, rainy weather it is difficult to check it, and at all times the best method of control is preventive.

Mosaic disease of tobacco.—This disease causes a mottled appearance on the leaf of light-green and dark-green areas, which often result in wrinkling and corrugation of the leaf. The leaves may be distorted into various shapes, sometimes long and thin or thick, and sometimes they take on peculiar shapes as to look very unlike tobacco leaves at all. Diseased leaves are worthless, as a rule.

The results of many investigations upon this disease seem to show that it is in some way due to an abnormal condition of the living matter of the plant itself, and that this something is capable of infecting and producing the disease in other plants. It is generally believed that anything which interferes with the normal development of the plant may bring on the disease at any time.

The methods of control would seem to be sterilization of seed-beds discarding all diseased seedlings, avoiding heavy or poorly drained soils and too much nitrogen, pulling out and burning diseased plants that occur in the field, and keeping the crop cultivated well. In topping and suckering, diseased plants should not be touched as the disease may be transmitted to the healthy plants.

Shed-burn or pole-rot.—This disease occurs in the curing-barn, and can be recognized in mild cases by small dark spots which develop on the leaf in the curing-barn, the entire contents of which may be destroyed within a couple of days or so in severe cases. It is due directly to too close hanging and poor ventilation in the curing-barn associated with damp or foggy warm weather. As a rule the disease does not occur in the barn until the leaf is changing from the yellow to the brown colour. At this stage the leaf is commencing to die or starve. The disease has been shown by Sturgis at the Connecticut Experiment Station to be due to fungi and bacteria. These organisms come from the soil and infest the plant in the field. The only means of controlling them is preventive.

It has been shown that these organisms make little or no growth at temperatures below 60 degrees or a relative humidity below 85 degrees. From this it can be seen that ventilation, plenty of space between tobacco when hanging in the barn, and properly constructed barns so built that they can be opened and closed are the best means of controlling the disease. Charcoal heaters and furnace-flues may also be used in prolonged wet weather.

GROWING TOBACCO SEED

Selecting the seed-plants.—There is no field plant with which more careful selection and discrimination should be shown than tobacco when selecting plants for seed. Ten or twelve choice plants should be chosen before the bud or button is large enough to remove. The same number of leaves should be left on the seed-plant as on the general-crop plants, but no more than that. Before the blossoms open, the seed-head is covered with an ordinary manila paper bag in order to prevent cross-pollination. Out of the number selected for seed select two or three of the best plants at the end of the season and discard the remainder. Plants having leaves of good width and length are desirable. The biggest are not necessarily the best, for this may be due to coarseness. The leaf should possess good texture, be thick and gummy, and the veins should not be coarse. The leaves should be close together on the stalk. The stalk should be light-green and tender as this type cures readily. The coarse stalk is to be avoided.

Care of the seed-plants.—A week or ten days after bagging the seed-head, the bag should be lifted up, and all fallen blossoms shaken out, and new growth and superfluous material removed. The bag should be fastened over the seed-head again and allowed to remain for about three weeks. At the end of this time it can be removed permanently, and all buds which have not blossomed should be removed. The seed-heads may be harvested when most of the pods are brown or nearly so, and hung in a dry, well ventilated place to dry.

Cleaning the seed.—The seed pods may be pulled from the heads, shelled, and mailed to the Experimental Station, Harrow, Ont., or to the Tobacco Division, Central Experimental Farm, Ottawa, postage free. The seed will be thoroughly cleaned, all light immature seed removed, and the large, plump, mature seed, having high and strong germinative power, returned to the tobacco-grower free of charge.

Tobacco seed-grades.—The machine shown herewith separates the seed into four grades. Grade No. 1 and No. 2 are kept, and No. 3 and No. 4 are discarded. An experiment was made on the Experimental Station, Harrow, with

these seed-grades in a plant-bed. Grade No. 1 and No. 2 germinated at once, and a uniform stand of vigorous plants was secured. Grade No. 3 produced a very poor, irregular stand of unthrifty plants. The germination was a week to ten days later than the better grades of seed and very irregular. Grade No. 4 was very much poorer than No. 3.

Fig. 13.—Seed-cleaning machine used by the Tobacco Division for cleaning tobacco seed. The machine separates the seed into four grades. Grades number three and four contain the light seed that must be discarded.

TOBACCO-BARNS OR CURING-SHEDS

There is a great need for better curing-barns for White Burley. It is quite common to scaffold the ordinary general farm barn, knock off a few boards, and hang the tobacco inside, too close for the amount of ventilation possible. If such boards as are knocked off were hinged to permit of their being opened and closed at will the barn would be much improved as a shed in which to cure tobacco, because the temperature and ventilation of the barn could then be somewhat controlled. Tobacco has been observed in almost every kind of a shed, and when the fall is exceptionally good for curing tobacco, fair results have been secured, but taken over a period of five to eight years the better quality and curing obtained in a good barn will more than pay for the barn.

The barn should be tight, but should have ventilators one foot wide every four feet apart in the horizontal or vertical direction. Horizontal ventilators are usually 12 or 14 feet long. The vertical ventilators should be hinged at the top of the wall of the barn to permit of their swinging out to ventilate the barn.

In the best air-curing barns, a great deal still depends on outside weather conditions. The size of the barn to be built depends on the acreage to be grown, up to a capacity for housing ten or twelve acres. The most common-size curing-barn generally recommended is 36 to 40 feet wide by 16 to 20 feet high by 100 to 150 feet long, with a driveway lengthwise through the centre of the barn. The tier-poles for the tobacco to hang on are three feet eight inches to four feet from centre to centre in the horizontal, and four feet apart in the vertical direction.

A barn 36 to 40 feet wide by 20 feet high and 100 feet long will properly house eight to ten acres of good Burley tobacco.

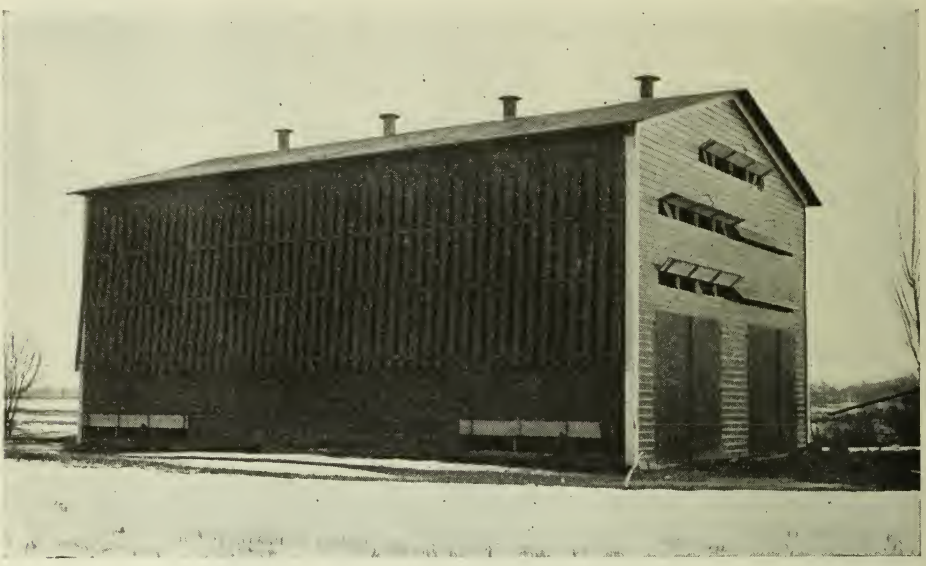

Fig. 14.—A curing-barn with plenty of ventilation.

HARVESTING

The harvesting period generally commences about the 15th to 20th of August, and is continued till the 10th of October if the frost does not come before that date. The proper date for harvesting depends on the maturity of the crop. If the crop has been planted from the 24th of May to the 15th or 20th of June, it will be ready to harvest from the 15th of August to the 20th of September. Harvested at this time the crop cures well, and with better colour on account of having the advantage of a long fall, and, usually, of good weather.

Maturity.—Maturity or ripeness in the plant is shown by large numbers of mottled yellow spots on the surface of the leaf, and by the brittleness of the leaf-veins. When the mature leaf is folded back between the fingers it will break leaving a clear mark. The veins will also snap distinctly when thus folded back. Usually in about 30 to 38 days after topping the plants are ready for harvesting.

Methods of harvesting.—There are two methods of harvesting. One consists of splitting the stalk with a knife down to about one-third of its length from the ground, and cutting it off, leaving it till wilted, and then placing five or six plants on a tobacco stick, or lath four feet long, and hauling to the barn.

The other method consists of cutting the plants, leaving them where cut till wilted, and then with a steel needle, which fits on the end of the lath, five or six plants are strung or needled on to each lath. The laths containing the tobacco are then hauled to the barn on a specially framed wagon.

In a harvesting experiment which was carried on at the Harrow Experimental Station to compare splitting the tobacco stalk vs. needling the stalk, it was found that it required two to four weeks longer for the needled tobacco to cure than was required for that with the split stalk. The cured leaf from the split stalk was brighter than that from the needled stalk. It was also found that less labour per acre was required for harvesting by the split stalk method. The split-stalk method is the one most generally used throughout Kentucky for harvesting White Burley.

Fig. 15.—Spearing tobacco plants on laths.

Scaffolding in the field is sometimes done. In an experiment conducted on scaffolding vs. cutting and hanging in the barn as soon as wilted, it was found that White Burley could be scaffolded in the field safely for about three days in fair weather, resulting in a little quicker and brighter cure being obtained. If scaffolded in the field for a longer period than three days, the tobacco leaf seemed to lose its lustre and take on a weather-beaten appearance which never disappeared even after the leaf was thoroughly cured. Scaffolding permits of closer hanging in the barn. Also permits of the cut tobacco plants being hauled into the barn in the morning while the dew is drying off the uncut tobacco in the field.

Precaution to be observed in harvesting.—Do not harvest the tobacco while the dew is on it, or immediately after rain.

The most common method of harvesting in Canada is to cut the plants and, as soon as they are wilted, to place them in small piles in the field. Often the tobacco is very soon needled and hauled to the barn. However, in a great number of instances it has been noted that tobaco has been left in the field in small piles for a week or sometimes longer. Often it has come under observation that tobacco so handled has had two or three rains on it before being hauled to the curing-barn. Tobacco of quality cannot be produced in this way. This would even be very poor practice in growing hay. As soon after cutting as the tobacco becomes wilted it should be either scaffolded in the field or hauled to the barn. There is nothing gained by piling the tobacco in the field for a few days even if the weather keeps fine. There may be little damage done to the tobacco

if left in small piles for only a day provided the weather is fine, but it should never be left longer. The tobacco should not be handled from the piles early in the morning when the dew is on because sand and dirt stick to the leaves.

During cutting, needling, piling, and hauling to the barn, every precaution and care should be taken to avoid bruising or tearing the leaves. A specially-built rack for hauling the tobacco from the field will be found very convenient in this connection and will save money and labour for the grower.

Hanging in the barn.—The tobacco should be very carefully handled when hanging it in the barn. The greatest care should be taken in spacing the laths on the poles of the curing shed. Every bruised spot on the leaf, no matter how slight, shows on the cured leaf and injures its quality. By establishing a reputation for quality and keeping it up, the grower can make good profits year after year in growing tobacco.

Fig. 16.—Wilting on improvised scaffold.

In the barn the four-foot sticks, or laths, having five to six plants each, are hung about 10 inches apart on the tier-poles, which are 3 feet 8 inches to 4 feet from centre to centre. The poles are 4 feet apart vertically. Shaking the plants when they are being hung in the barn will prevent the leaves from sticking together. If the leaves stick together they are much more liable to pole-or shed-burn and do not cure out a uniform colour.

CURING

White Burley tobacco is air-cured, i.e., hung in barns and cured under ordinary atmospheric conditions. From this it should not be inferred that curing is simply drying of the leaf, because it involves many essential chemical changes which take place in the leaf during the curing period. On these chemical changes taking place properly depend the curing and, to a large extent, the quality of the cured leaf.

Fig. 17.—A very convenient rack for hauling tobacco from the field to the barn.

Fig. 18.—A new type of tobacco-rack. Can be loaded by a single man and reduces the risk of breaking the leaf to a minimum.

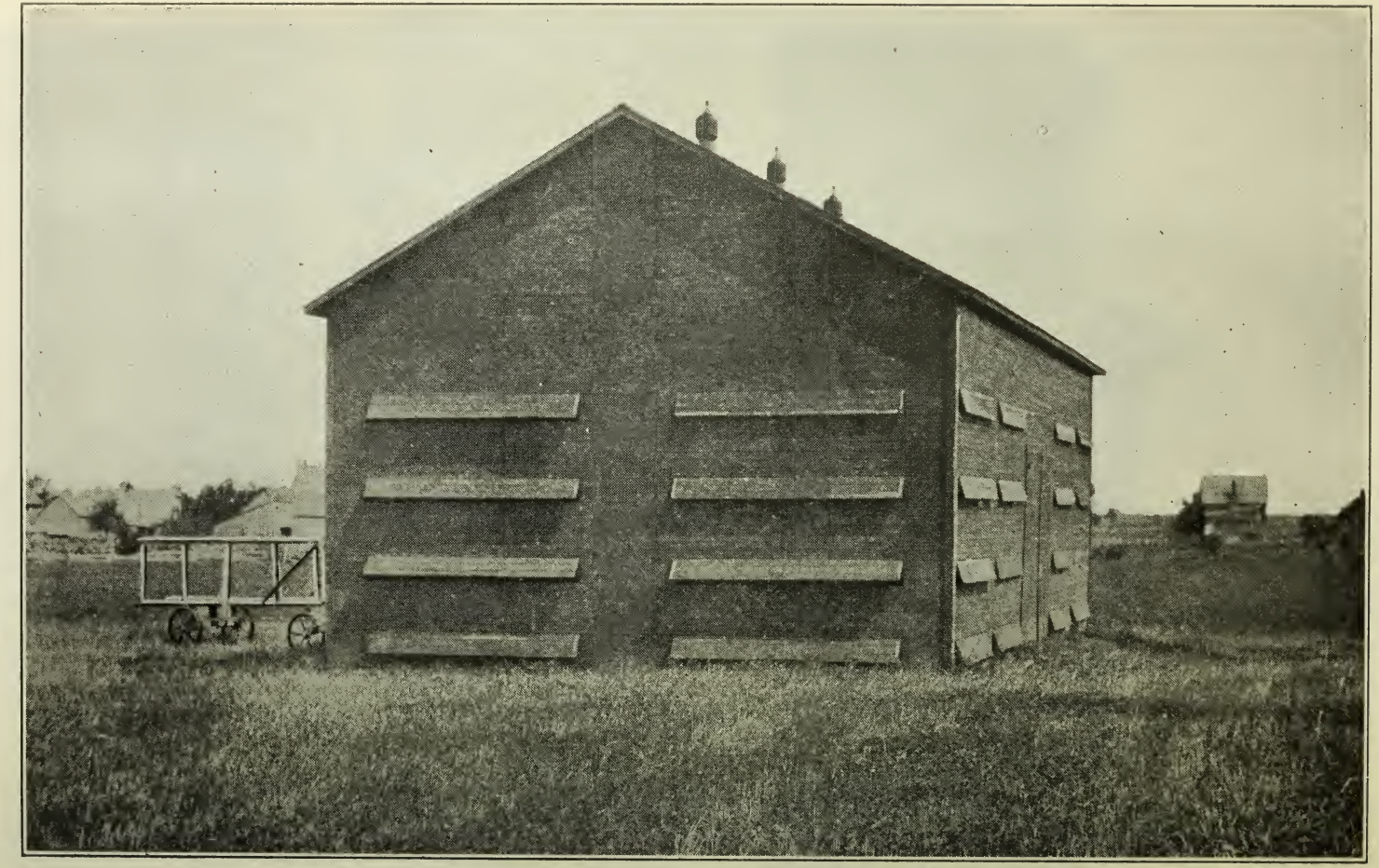

Fig. 19.—A type of curing-barn recommended for Quebec. Has also given excellent results in southern Ontario.

The prime requisite in managing the barn during curing is that it be well ventilated. Side and top ventilation should be provided on all barns used for curing tobacco.

Attention required.—The barn should be opened in the morning and kept open all day under normal conditions, and closed at night in damp or cool weather. If the nights are warm and clear during the first couple of weeks or more the barns may be left open both day and night. If, however, the weather is very dry the barn should be closed during the day and opened at night in order to prevent too rapid drying out of the leaf. When the leaf becomes yellow the humidity in the barn should be lowered so that the reddish colour may be developed.

Fig. 20.—Special heater in which to make charcoal or coke fires in tobacco-barns, to prevent or control moulds and pole-burn.

The most trying time in curing is during fog and warm, rainy periods when very little air is stirring. During such weather the barn should be kept closed until the air on the inside begins to be saturated with moisture. The saturation of the air is indicated by the sweating of the tobacco and the stiffening of the midribs. The barn should then be opened and the air allowed to change if there is any draught. If there is no draught, open fires of coke or charcoal, or fires in special heaters fitted with a grate may be used to create a draught. This not only applies in serving to keep the curing normal, but also serves to prevent pole- or shed-burn, and control the moulds.

Heaters.—Figure 20 shows the type of heater recommended. These heaters should be placed at intervals of ten to fifteen feet apart over the floor of the barn in order to secure even distribution of heat because this is very essential, otherwise local draughts are created and little or no good is effected. Quick firing and thus drying out the barn as soon as possible is recommended. The slow fire may do more harm than good by raising the temperature to one more favourable for mould development.

HANDLING AFTER CURING

Taking down cured tobacco.—After the leaf is thoroughly cured the next operation is "stripping," or pulling the leaves off the stalk. Before stripping, the tobacco is allowed to come into "case," that is, absorb enough moisture to permit of handling without breaking the leaves. The tobacco comes into case during moist weather, and it may be taken down and packed into square piles or bulks in order to keep it from drying out. Care and judgment are required in taking down and bulking tobacco in the proper case. If it is going out of case when taken down it will continue to go out and become dry in the piles. Much breaking of leaves will then occur in getting it hung so that it will come in case again. High case must be guarded against as moulds will attack the tobacco if the weather becomes warm and moist. The colour of the leaf darkens somewhat if the tobacco is bulked when in high case. Tobacco which has been taken down in the proper case, piled properly, and covered, will keep in good stripping order till the summer sweat, or till May or June. The crop should be stripped before this time, however.

STRIPPING

Stripping may be done when the tobacco is in case any time after curing. It is usually delayed under our system of marketing till the tobacco is sold. The leaves should always be stripped and graded at the same time. In the southern United States, stripping consists in removing the leaves from the stalk, classifying them into the natural grades that occur on the plant, and tying in "hands" of fifteen or twenty leaves. Thus stripped and tied the tobacco is ready for market. Commencing at the bottom of the plant and working towards the top these natural grades are six in number as follows:—

1. One or two leaves of flyings. 2. Two to four leaves of trash. 3. Two to four leaves of lugs. 4. Two to four leaves of bright leaf. 5. Two to four leaves of red leaf. 6. Two to four leaves of red tips. The various grades can easily be distinguished by differences in the colour, texture and body of the leaves. Badly damaged leaves should be tied separately. On the accuracy of grading in a large measure depends the price.

So far the only attempt at grading in Canada has been the separation of the leaf into sand leaves, leaf, and tips as directed by the buyers. This is not grading at all, but only serves to make grading easier after the tobacco has been delivered by the grower.

The same number of grades occur in Canada as in the southern United States, and when grading is done on the farm by the growers the percentage of the better grades will be increased, and the percentage of the poorer grades will be decreased, if the tobacco is sold by grade and quality.

Care after stripping.—After the tobacco is stripped and graded it should be baled, putting each grade in separate bales. The size of the bale varies from sixty to one hundred pounds.

A box form is used for baling in order to secure uniformity and evenness. The most common size is 36 to 40 inches in length, 12 to 14 inches wide and 18 to 20 inches deep. The tobacco is pressed by screwjacks or levers in order to make a solid bale. The leaves should be kept straight in baling.

MARKETING

The present system of marketing in Canada is the "crop run" or whole crop at a certain contract price made between the grower and buyer at any time during the year. It may be made before the crop is planted, before harvest, or after the crop is cured, but usually before it is stripped. Such a system has advantages for the grower after the buyer has graded sufficient crops to know

Fig. 21.—Tobacco packed in baskets ready for the auction sale. (By courtesy Kentucky Agricultural Experiment Station.)

Fig. 22.—A typical sale group on the Kentucky loose-leaf market. (By courtesy Kentucky Agricultural Experiment Station.)

what percentage of certain grades is obtained and the value of these grades. It takes less labour for the grower to handle the crop under this system, but it does not follow that more labour could not be profitably employed under a better system of marketing. Our system of marketing is very poor. In buying this way a certain amount of guessing must always be done as to the value of the crop.

The system followed in the southern United States is as follows:—

The tobacco is stripped, and separated or graded into six or more grades, and tied into hands of fifteen or twenty leaves on the farm by the grower. It is then loaded into wagons, each grade kept separate, and hauled to large warehouses built with great floor space and excellent lighting facilities, especially for marketing tobacco. At the warehouse the wagon is unloaded, and each grade placed on separate "sales baskets" which are about five to six feet square and about three inches deep. The baskets are not allowed to contain more than 700 pounds, because a larger quantity cannot be sufficiently inspected by the buyers during sale. The hands are packed on to the baskets, butts out in order to decrease damage. The packing on to baskets is usually done by the warehouse employees, but the grower may supervise this if he desires. After the baskets are packed they are placed on trucks and run on to scales and weighed. Record of weight and grower is made on a card and a number stamped on the basket. The baskets are then placed on the floor close together in rows which may run the length of the warehouse. Aisles are left for auctioneers, buyers, and others to pass between rows. Sales commence at nine o'clock daily and continue throughout the day with a recess at noon. The tobacco is sold at auction to the highest bidder. The auctioneer takes his place beside the basket and cries it. The floor manager of the warehouse works one basket ahead of the auctioneer and buying crew, and states what he thinks is the minimum value of the basket. The auctioneer may go below this to get the bidding started. If the farmer does not like the price he may refuse the highest bid, and sell the tobacco at some later date. The sales are very rapid, each auctioneer selling from 200 to even as high as 500 baskets per hour, the latter figure being a record. The buyers may be representatives of the large and small tobacco factories, representatives of the foreign government monopolies, brokers buying on commission or for speculation, and speculators or "pin hookers" as they are known to the trade. Lexington, Kentucky, U.S.A., is the largest such market in the world. About 35,000,000 (thirty-five million) pounds of Burley are sold annually on this market.

MISCELLANEOUS

Distribution.—The world's supply of White Burley comes from Kentucky, U.S.A., largely. A small amount is grown in West Virginia, Ohio, and Ontario.

Uses.—It is used for plug, both chewing and cutting for pipe-smoking, twist, granulated smoking-tobacco, and cigarettes.

World crop of White Burley.—The annual crop amounts to approximately three hundred and fifty to four hundred million pounds.

Markets.—The largest markets in both Canada and the United States for White Burley are the home markets of each. From the United States it is exported to Germany, Austria, Italy, France, and England.

Acreage.—The largest total acreage ever devoted to White Burley in Canada was about twenty thousand acres. In the United States it is from three to four hundred thousand acres.

REFERENCES

1. Bulletin No. 21, "Tobacco Seed Beds."—Tobacco Division, Central Experimental Farm.

2. Bulletin No. 41, "Summary Three Years Experiments on the Harrow Tobacco Station."

3. Bulletin No. 139.—Kentucky Experiment Station.

4. Bulletin No. 38.—Tobacco Division, Central Experimental Farm.

PUBLICATIONS ON TOBACCO-CULTURE

The following publications of the Department of Agriculture relating to tobacco-culture are available on application to the Publications Branch, Department of Agriculture, Ottawa:—

Tobacco-Culture in Canada .....Ex. Cir. 19
Tobacco-Growing in Canada .....Bul. 25, S.S., E.F.
Tobacco Seed-Beds .....Bul. 21, S.S., E.F.
Tobacco, Summary of Three Years' Experiments at Harrow.....Bul. 41, S.S., E.F.
Flue-Cured Tobacco in Canada.....Bul. 38, S.S., E.F.
Heating-Appliances for Flue-Curing Tobacco.....Pamp. 51, N.S.

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